



# KS 98-1

## Multi-function unit

All automation functions in a single unit

Controlling, computing, sequencing, programmer

Visualization, operation, alarm processing

Comprehensive function library

Red/green LCD matrix display (selectable)

I/O expansion via Module C or CANopen bus

Graphical engineering tool and simulation

Front and rear interface ports

Protection class IP 65

Certified to DIN EN 14597 and cULus

advanced line

### GENERAL

Many years of experience as well as valuable feedback from users have been implemented in the new multi-function unit KS 98-1.

The high-resolution LC display (160 x 80 pixels) permits operation and display also in unfavourable lighting conditions and viewing angles, thus reducing possible operating errors.

Moreover, the library functions have been expanded and adapted to user requirements, for example:

- Reduced operating errors with menus that have been adapted individually to the process and user requirements in national languages.
- Situation-dependent disabling of unwanted settings and switchovers requiring access rights (password, control signal, etc.).
- Language selection simplifies the changeover from commissioning to the user's language.
- Selection and display of e.g. recipes, and entry of actions in plain operator's language prevent misunderstandings and errors.
- Automatic and manual direct selection of display pages without detours via menus ensure fast operator response.
- Event-driven switchover of display colour (red/green) and display mode (direct/inverse) increase operator awareness.

- Scrolling through operating pages prevents error-prone page changes in long selection lists.
- An alarm page clearly lists all events in the sequence of their occurrence. Alarm acknowledgement is done via the front panel.
- Trend displays with zoom function are useful for monitoring.
- Bargraph displays also show the adjusted min/max limit values.
- Controller with setpoint selection and adjustment from the front.
- Display and operation of cascaded control loops.
- Modular programmer with recipe selection in plain text, auto/manual operation, manual or automatic search, master/slave control outputs, etc.

### DESCRIPTION

Flexible adaptation of automation systems to the number and type of required inputs/outputs is essential for the optimization of decentralized application solutions in terms of function, availability, and cost.

Additional signal transmitters and the associated costs for installation can be omitted, if these functions are already provided, and are supported by suitable Engineering Tools.

Easily operated engineering tools with simulation and trend recording functions enable users without programming know-how to develop their own control concepts, fine-tune them, and

finally test them on a PC before hot commissioning.

The integrated self-tuning function with the reliable PID tuning procedure considerably reduces commissioning times – also with problematic and difficult processes.

A front interface port provides fast access with a PC. This permits parameters to be adjusted and checked, thus avoiding errors.

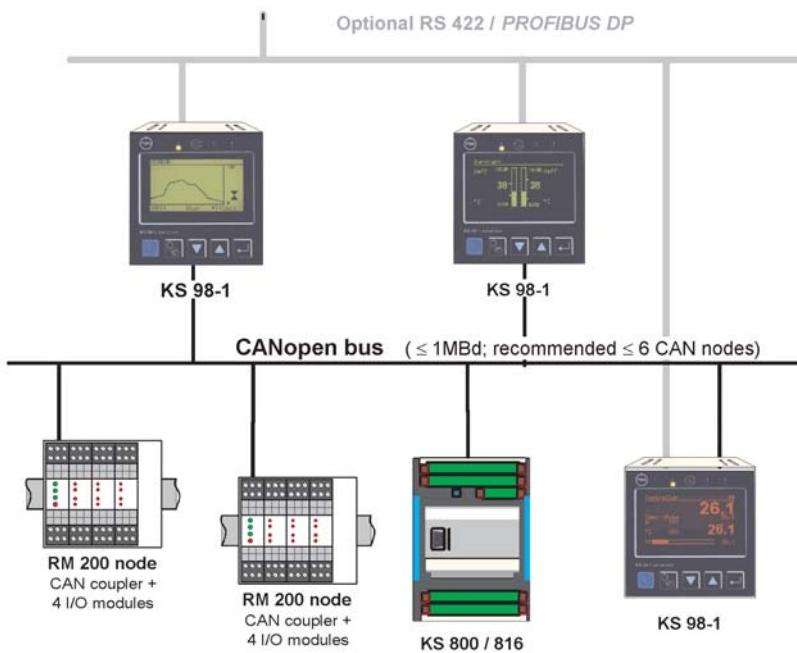
Decentralized solutions reduce the investment costs and increase system transparency. Connection possibilities for widely used field busses such as PROFIBUS or INTERBUS allow the implementation of logical and spatially distributed concepts with local operation and display facilities.

### De-centralized I/O extension

By adding an additional CANopen interface, the standard version of the multi-function unit KS98-1 offers:

- facilities for local I/O extension by means of PMA's modular I/O system RM200.
- connection to PMA's multi-temperature controllers KS 800 / KS 816.
- local data exchange with other KS98 and KS98-1 units (cross-communication).
- If required, other sensors, actuators, transmitters, sequence control devices, machines, etc. can be connected via the CANopen protocol.

Fig.1 : CANopen I/O expansion with connection to supervisory systems



Data exchange between the parties is done directly via the CAN master, without detours.

The max. number of parties on the CANbus depends on the amount of transmitted data and the logic assignment of the parties.

We recommend max. 6 parties on the CANbus (1 master and 5 slaves). In all cases, it will be necessary to check whether the intended communication setup is feasible. Detailed descriptions of the communication functions are given in the KS 98-1 operating manual.

### **Integrated I/O Extension**

#### **(Modular Option C)**

By means of the "Modular Option C", the inputs and outputs of the multi-function unit KS 98-1 can be adapted individually to the application.

The motherboard is mounted firmly in the unit. It contains four sockets for various types of I/O modules that can be combined in the same unit. Exceptions see *POWER LIMITATIONS!*

Every module is designed for two channels (a, b) exceptions → connecting diagram.

Depending on the ordered version, the modules are mounted in the KS 98-1 or shipped separately. Retrofitting by

the customer is possible without recalibration.

Fig.2: Integrated I/O-modules



### **INPUTS AND OUTPUTS**

Input INP1 is designed as a universal input for direct connection of all conventional sensors and standard signals.

All other analog inputs are dedicated for current, voltage or potentiometer signals. Galvanically isolated areas are marked in the connecting diagram (Fig. 12).

All digital I/O are designed for 0/24 V signal levels, and have opto-coupler isolation.

### **RM 200-modules (CANopen)**

See datasheet RM200  
(9498-737-37813)

#### **Modular Option C**

##### **Analog inputs**

R\_INP: Resistive measurements  
TC\_INP: Thermocouples, mV, mA  
U\_INP: Voltage ( $R_{in} > 1\text{G}\Omega$ )

##### **Analog outputs**

U\_OUT: Standard voltage signals  
I\_OUT: Standard current signals

##### **DIDO: Combined digital I/O**

Both channels can be configured separately as input or output. The operating sense is reversible.

##### **F\_INP: Frequency & counter inputs**

The following functions can be selected:

- Digital input
- Frequency counter

For measurement of rpm, mass flows of energy, gases or liquids that are available as a frequency signal.

- Up counter

For totalizing mass flows of energy, gases or liquids that are available as a frequency signal.

- Up/down counter

Counting the pulse difference of two clock signals. The result remains unchanged, if a signal change is detected at both inputs simultaneously.

- Up/down counter with direction signal

For the connection of shaft encoders, position measurement systems or flow meters that provide a direction signal together with the measurement signal. The direction signal must either be static (0 or 1) or be identical to the measurement frequency but with a 90° shift.

Depending on the direction signal counting is upwards or downwards if a negative flank is detected.

- Quadrature counter

Same function as for the "Up/down counter with direction signal", but the double amount of pulses is measured, because every signal change is registered (doubled resolution!).

- Control signals

All counter functions provide a STOP and a RESET input, which can be configured via the Engineering.

## FUNCTION LIBRARY

Max. 450 functions are available with the graphic Engineering-Tool ET/KS98plus.

Every function needs a certain amount of working memory and a certain amount of computing time.

Computation of the function blocks is executed in selectable segments of equal time 100, 200, 400 or 800ms.

### Determining computing capacity

#### Computing capacity and RAM

The maximum RAM and computing time for the selected library functions are computed and surveyed by the Engineering-Tool.

#### In-/Outputs and CANopen

In order to check whether a particular application is possible with the KS 98-1, the quantity and type of inputs/outputs, the number of required functions, and the corresponding memory requirements must be determined roughly.

Scanning times	
INP1	200 ms
INP3, INP4	100 ms
INP5	800 ms
INP6	400 ms
di1...di12	100 ms
OUT1...OUT5	100 ms
di1...do6	100 ms
I/O-Module (Option C)	100 ms
RM200-node	100 ms
RM200-datablock	100 / 200 / 400 / 800 ms
Cross communication	200 ms
KS800 / KS816	1.6 / 3.2 s (200 ms per channel)

#### Modular Option C

For reasons of max. permissible self-warming, the number of usable analog output modules per basic card is limited:

- The sum of power factors (P-factor, → TECHNICAL DATA) must not exceed 100%!
- P-Factors*
- R\_INP / TC\_INP: 5%,  
U\_INP / F\_INP: 8%,  
U\_OUT: 25%, I\_OUT: 75%,  
DIDO: 15%
- Maximum one I\_OUT module!
  - Maximum one additional U\_OUT module, if already a I\_OUT module is plugged (but in a different galvanically isolated module group) !

- Modules I\_OUT or U\_OUT must not be combined with input module U\_INP within the same galvanically isolated module group!

Exceedings are indicated in the Engineering Tool.

#### Example:

Current output module on socket 1 or 2, and voltage output module on socket 3 or 4. The sum of P-factors is 95%. Thus, a further module (either RT or TC/mV/mA) can be added.

## SERIAL INTERFACES

By means of „soft wiring“, any configured data can be sent to an interface. The front interface is always fitted. It is not bussable, but is used to connect the PC with the Engineering Tool.

The rear bus interface is optional (option B) and can be used for networking the KS 98-1 within an automation system.

## GALVANIC ISOLATION

Galvanically isolated groups of terminals are marked in the connecting diagram Fig.12.

#### Signal and measurement circuits

Isolation of working voltages up to 50 Vr.m.s. against ground according EN 61010-1 (for functional reasons; dotted lines).

#### Mains circuits 90 ... 250AC, 24 VUC

Isolation of working voltages up to 300 Vr.m.s. against each other and against ground according EN 61010-1 (for safety reasons; full lines).

## OPERATION AND DISPLAY

All configuration, parameter setting and operational data of the selected function blocks can be changed via the front-panel keys of the KS 98-1. For commissioning, the input and output values can be displayed.

#### Operating pages

With the appropriate library functions standard operating pages are set up automatically for single-loop and cascading controllers, programmers, bargraph displays (horizontal and vertical), trenddisplays, alarm- and eventlists.

The operating pages can be selected directly driven by event, manually via the general operating page VWERT or via the operating menu.

The VWERT function allows the design of an operating concept tailored for the application in the language of the operator.

Selected parameters from the engineering can be made accessible for the operator via the VPARA function.

Particular operating pages can be hidden or made accessible depending on the situation.

#### Disabling

Depending on the application, different demands are placed on the disabling functions for operation, parameter setting, or configuration.

Disabling can be controlled via the digital inputs, by means of internal wire-hook switches, by a defined internal status, or with access codes.

Typically, the entire operating level, parameter adjustment and configuration, or the operation of certain functions can be disabled.

## ENGINEERING TOOLS

### Graphic Engineering Tool ET/KS98

In principle, the Engineering Tool for the KS 98-1 consists of a function block editor.

- Functions are selected from menus, and placed in the working area of the PC's display.
- Graphical connections between inputs and outputs.
- If a function is moved on the screen, its connections are maintained automatically.
- Configuration and parameter setting of the functions.
- Down-loading as well as re-reading the completed program to the KS 98-1.
- Password protection for the created engineering
- Management of adjustments and recipees.
- Connection to PC via front-panel interface (PC adapter required).

- If the connection is made via the rear bus interface, an RS 232 → RS 422/485 adapter, and possibly an interface adapter are necessary.
- The manual of the KS 98-1 is part of the Help system.

## Simulation SIM/KS 98

The KS 98-1 with extension and RM200 modules is simulated on the PC, complete with operating functions and displays. Inputs can be assigned, and output statuses displayed.

This enables all functions and operating menus to be tested in advance, and modifications carried out before hot commissioning.

Moreover, the simulation contains a control loop with adjustable dynamic behaviour, so that controllers can be tuned and commissioned in a closed loop.

Additional functions:Trend display, online function, and 'turbo' mode.

## BlueControl® KS 98-1

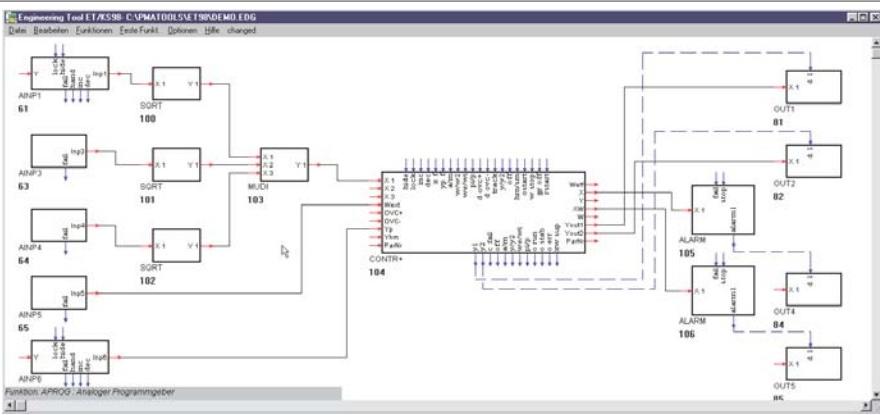
BlueControl® provides a clear display and simple adjustment of selected parameters in the Explorer. This prevents accidental/unauthorized changes to the Engineering.

Similarly, a password-protected set of standard parameters can be defined and saved as a basic setting, and then transferred to other controllers operated with the same Engineering.

## Downloader DL / KS 98-1

This tool creates an unchangeable and tamper-proof data set of the Engineering that can be transferred to a KS 98-1 for the purpose of correction or for multiple use in several controllers. Password protection can also be defined here.

Fig. 3 Example of an engineering for the KS 98-1



## TECHNICAL DATA

### INPUTS

Depending on version and selected options, the following inputs and outputs are available:

	DI	DO	AI	AO
STANDARD (4 relays) oder		OUT1 di1 di2	INP1 INP5 INP6	—
		OUT2 OUT4 OUT5	INP1 INP5 INP6	OUT1 OUT2
STANDARD (2 relays + 2AO)	di1 di2			
OPTION B (additional)	di3 di4 di5 di6 di7	do1 do2 do3 do4	—	—
OPTION C (additional)	di8 di9 di10 di11 di12	do5 do6	INP3 INP4	OUT3
Modular Option C				Depending on module type

### Universal input INP1

Limiting frequency: fg = 1 Hz  
Measurement cycle: 200 ms

### Thermocouples

according to DIN IEC 584

Type	Range	Error	Resolution
L	-200...900°C	≤ 2 K	0.05 K
J	-200...900°C	≤ 2 K	0.05 K
K	-200...1,350°C	≤ 2 K	0.072 K
N	-200...1,300°C	≤ 2 K	0.08 K
S	-50...1,760°C	≤ 3 K	0.275 K
R	-50...1,760°C	≤ 3 K	0.244 K
B <sup>1)</sup>	(25)400...1,820°C	≤ 3 K	0.132 K
T	-200...400°C	≤ 2 K	0.056 K
W(C) <sup>2)</sup>	0...2,300°C	≤ 2 K	0.18 K
E	-200...900°C	≤ 2 K	0.038 K

(1) Error & resolution values for 400...1,820°C.  
(2) W5Re/W26Re

With linearization  
(temperature-linear in °C or °F)

Input resistance: ≥ 1 MΩ

Cold-junction compensation (CJC): built in

### Input circuit monitor

Current through sensor: ≤ 1 mA

Reverse-polarity monitor is triggered at 10 °C below span start. The sensor's status can be processed in the engineering as a logical signal.

### Additional error of internal CJC

≤ 0.5 K per 10 K terminal temperature  
External temperature selectable:  
0...60 °C or 32...140 °F

### Resistance thermometer

Pt 100 to DIN IEC 751, and temperature difference 2 x Pt 100

Range	Error	Resolution
-200...250.0 °C	≤ 0.5 K	0.024 K
-200.0...850.0 °C	≤ 1.0 K	0.05 K
2 x -200...250.0 °C	≤ 0.5 K	0.024 K
2 x -200.0...250.0 °C	≤ 0.1 K	0.05 K

Linearization in °C or °F

Two or three-wire connection.

Two-wire connection with lead resistance adjustment.

Lead resistance: ≤ 30 Ω per lead

Sensor current: ≤ 1 mA

Input circuit monitoring for sensor/lead break, and lead short circuit.

### Potentiometric transducer

R <sub>total</sub> incl. 2 x R <sub>L</sub>	Error	Resolution
0...500 Ω	≤ 0.1 %	≤ 0.02 Ω

Resistance-linear

Sensor current: ≤ 1 mA

Matching/scaling with sensor connected.

Input circuit monitoring for sensor/lead break, and lead short circuit.

### Resistance input

Range	Error	Resolution
0...250 $\Omega$	$\leq 0.25 \Omega < 0.01 \Omega$	
0...500 $\Omega$	$\leq 0.5 \Omega$	$< 0.02 \Omega$

### Direct current 0/4...20mA

Range	Error	Resolution
0/4...20 mA	$\leq 0.1\%$	$\leq 0.8\text{ mA}$

Input resistance: 50  $\Omega$

Input circuit monitor with 4...20mA:  
triggered when  $I \leq 0\text{ mA}$

### Direct voltage

Range	Error	Resolution
0/2...10 V	$\leq 0.1\%$	$\leq 0.4\text{ mV}$

Input resistance  $\geq 100\text{ k}\Omega$

### Signal input INP5

#### Differential amplifier input

Up to 6 controllers can be cascaded, if there is no other galvanic connection between them. If there is, only 2 inputs can be cascaded.

#### Direct current and voltage

Technical data as for INP1, except for:  
Limiting frequency: = 0.25 Hz  
Measurement cycle: 800 ms  
Input resistance (voltage):  $\geq 500\text{ k}\Omega$

### Signal input INP6

Limiting frequency: = 0.5 Hz  
Measurement cycle: 400 ms

### Potentiometric transducer

Technical data as for INP1, except for:  
 $R_{\text{total}}$  inkl. 2 x RL      Error      Resolution  
0...1000  $\Omega$        $\leq 0.1\%$        $\leq 0.04\text{ }\Omega$

### Direct current 0/4...20 mA

Technical data as for INP1

### Signal inputs INP3, INP4 (option)

Galvanically-isolated differential amplifier inputs.

Measurement cycle: 100 ms

### Direct current

Technical data as for INP1  
except  $R_i = 43\text{ }\Omega$

### Control inputs di1...di12

di1, di2: standard  
di3...d7: Option B  
di8...di12: Option C

### Opto-coupler

Nominal voltage: 24 VDC, external  
Current sink (IEC 1131 Type 1)

Fig. 4 Operating display for a controller (CONTR, CONTR+, PIDMA)

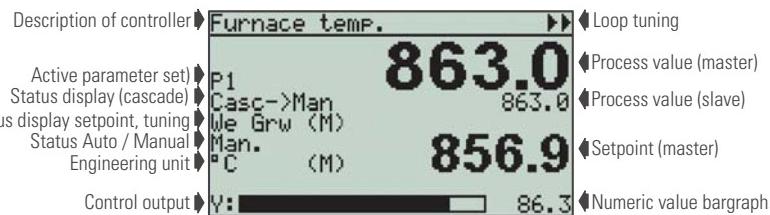


Fig. 5 Operating display for an analog programmer (APROG)

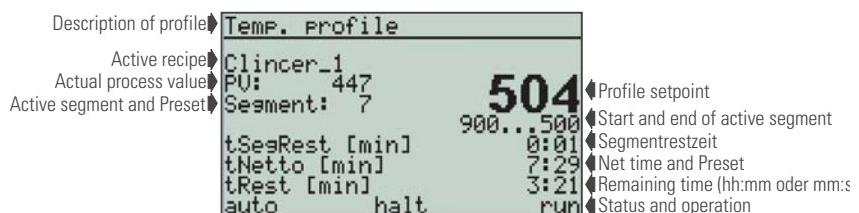


Fig. 6 Entry and display of 6 analog and binary values (VWERT)



Fig. 7 Trend display (VTREND)



Fig. 8 Horizontal bargraph display (VBAR)

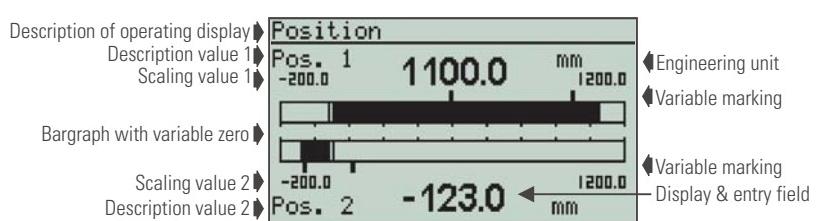


Fig. 9 Alarmlist (VALARM)



Logic „0“ (Low): -3...5 V  
 Logic „1“ (High): 15...30 V  
 Current demand: approx. 6 mA  
 (see Fig. 12 for galvanic connections and isolation).

### Built-in transmitter supply (optional)

Can be used to energize a two-wire transmitter or up to 4 opto-coupler inputs. Galvanically isolated.  
 Output:  $\geq 17.5$  VDC, max. 22 mA

### Factory setting

The transmitter supply is available at terminals A12 and A14, if INP1 is configured for current input and thermocouples.

By means of internal switches, the voltage can be applied to terminals A1 and A4, where it is always available, irrespective of the configuration.

## OUTPUTS

### Outputs OUT1, OUT2, OUT4, OUT5

Relay or current/logic signal, depending on version.

### Relay outputs

Relays have potential-free change-over contacts.

Max. contact rating:  
 500 VA, 250 V, 2 A with 48...62 Hz,  
 $\cos\phi \geq 0,9$

Minimum rating: 12 V, 10 mA AC/DC  
 Number of switching cycles electrical:  
 for  $I = 1A/2A \geq 800,000 / 500,000$  (at  $\sim 250V$  / (resistive load))

**If the relays operate external contactors, these must be fitted with RC snubber circuits to prevent excessive switch-off voltage peaks!**

Varistor protection is not recommended!

### OUT1, OUT2 as current outputs

Galvanically isolated from the inputs 0/4...20 mA, selectable

Signal range: 0...22 mA

Resolution:  $\leq 6$  mA (12 bits)

Error:  $\leq 0,5\%$

Load:  $\leq 600 \Omega$

Load effect:  $\leq 0,1\%$

Limiting frequency: approx. 1 Hz

### OUT1, OUT2 as logic signal

0 /  $\geq 20$  mA with a load  $\geq 600 \Omega$

0 /  $> 12$  V with a load  $\geq 600 \Omega$

### Output OUT3 (Option C)

Galvanically isolated

Technical data as for OUT1, OUT2

Fig. 11 Hardware and software structure

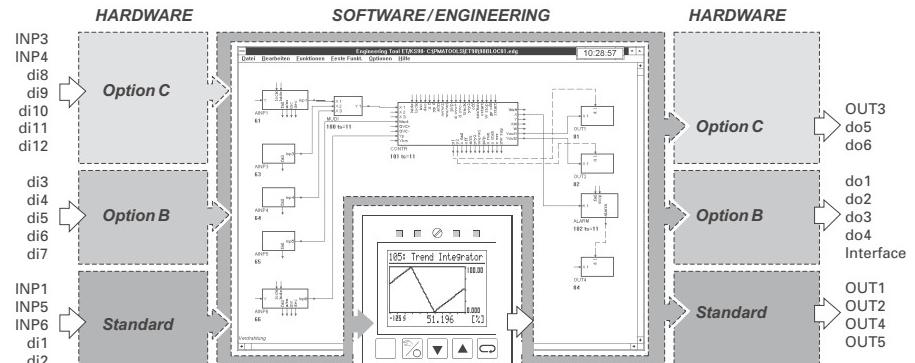
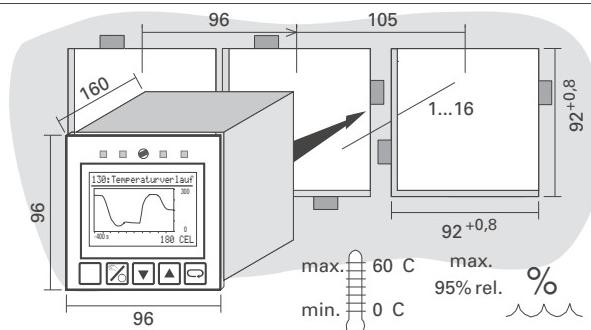


Fig. 10 Overall dimensions (in mm)



### Control outputs do1..do6

do1...do4: with Option B  
 do5, do6: with Option C  
 Opto-coupler outputs  
 (see Fig. 12 for galvanic isolation).

Grounded load:  
 common positive control voltage

Switch rating: 18...32 VDC;  $I_{max} \leq 70$  mA  
 Internal voltage drop:  $\leq 0,7$ V with  $I_{max}$   
 Protective circuit: thermal, switches off with overload.

Supply 24 V DC external  
 Residual ripple  $\leq 5\%$ ss

## MODULAR OPTION C

### ANALOG INPUTS

#### A/D-Converter

Resolution: 20,000 (50Hz) or 16,667 (60Hz) steps for the selected measuring range.

Conversion time: 20ms (50Hz) or 16.7ms (60Hz).

Measurement cycle: 100 ms per module

Method: Charge balancing

#### Input filter

Analog: 1st order,  $f_g=10$ Hz

Digital: 1st order,  $f_g=2$ Hz

### Resistive input module R\_INP

(9407-998-0x201, P-factor=5%)

Number of channels: 2 (with 3 and 4-wire connection, only one channel can be used).

With 2-wire connection, sensor types can be combined within one module!

Sensor current:  $\leq 0,25$ mA

### Resistance thermometer

Connection method: 2-, 3- or 4-wire connection

Type	Range °C	Overall error	Resolution K/Digit
Pt100	-200...850°C	$\leq 2$ K	0,071
Pt100	-200...100°C	$\leq 2$ K	0,022
Pt1000	-200...850°C	$\leq 2$ K	0,071
Pt1000	-200...100°C	$\leq 2$ K	0,022
Ni100	-60...180°C	$\leq 2$ K	0,039
Ni1000	-60...180°C	$\leq 2$ K	0,039

Linearization: in °C oder °F

Lead resistance

Pt (-200...850°C):  $\leq 30 \Omega$  per lead

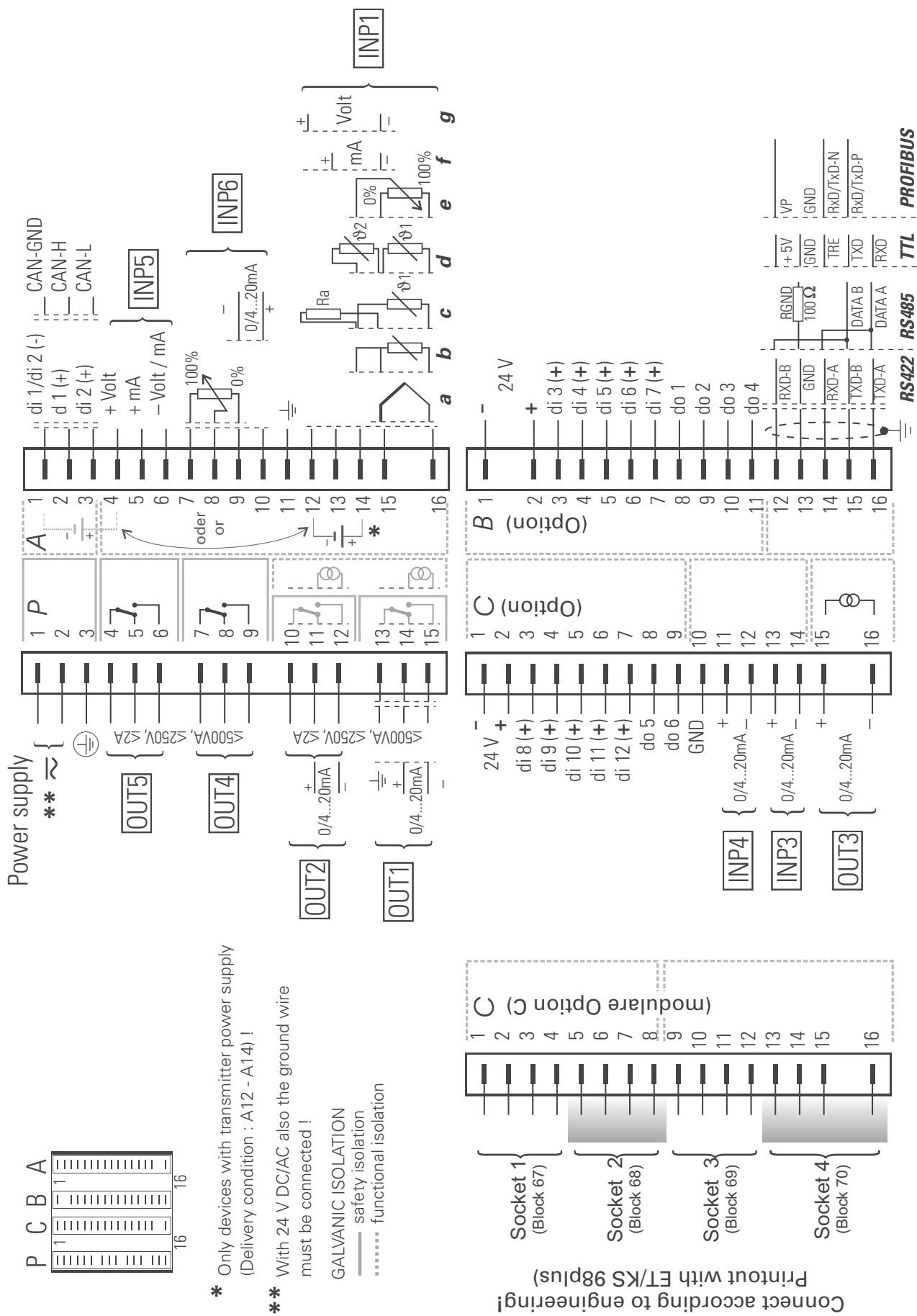
Pt (-200...100°C), Ni:  $\leq 10 \Omega$  per lead

Lead resistance compensation

3 and 4-wire connection: not necessary.

2-wire connection: compensation via the front with short-circuited sensor. The calibration values are stored in a non-volatile memory.

Fig. 12 Electrical connections



P C B A  
16 16

**Lead resistance effect**  
3 and 4-wire connection: negligible  
**Sensor monitoring**  
Break: sensor or lead  
Short-circuit: triggers at 20 K below measuring range.

### Resistance / Potentiometer

Connection method: 2, 3 or 4-wire connection  
Number of channels: 2 (with 3 and 4-wire connection only channel can be used).

Range R <sub>ges</sub> / Ω	Overall error	Resolution Ω/Digit
0...160	≤1%	0.012
0...450	≤ 1 %	0.025
0...1600	≤ 1 %	0.089
0...4500	≤ 1 %	0.025

**Characteristic:** resistance-linear  
**Lead resistance or 0%/100% compensation:** via the front with short-circuited sensor. The calibration values are stored in a non-volatile memory.

- Variable resistance (only 2-wire connection): calibration for 0%
- Potentiometer: calibration for 0% and 100%

### Lead resistance effect

3 and 4-wire connection: negligible  
**Sensor monitoring:** break: sensor or lead

## Thermocouple, mV, mA Module TC\_INP

(9407-998-0x211, P-factor=5%)  
Number of channels: 2 (difference input). Sensor types can be combined within one module !

### Thermocouples

To DIN IEC 60584 (except L, W/C, D)

Type	Range	Overall error	K/Digit
L	-200...900°C	≤ 2 K	0.080
J	-200...900°C	≤ 2 K	0.082
K	-200...1350°C	≤ 2 K	0.114
N	-200...1300°C	≤ 2 K	0.129
S	-50...1760°C	≤ 2 K	0.132
R	-50...1760°C	≤ 2 K	0.117
B <sup>(1)</sup>	(25) 400...1820°C	≤ 2 K	0.184
T	-200...400°C	≤ 2 K	0.031
W(C)	0...2300°C	≤ 2 K	0.277
D	0...2300°C	≤ 2 K	0.260
E	-200...900°C	≤ 2 K	0.063

(1) Values apply from 400°C

**Linearization:** in °C or °F

Linearity error: negligible

**Input resistance:** ≥1 MΩ

**Temp. compensation (CJC):** built in

Error: ≤ 0.5K/10K

External CJC possible: 0...60 °C or.

32...140 °F

**Source resistance effect:** 1mV/kΩ

### Sensor monitoring:

Sensor current: ≤ 1 μA

Reversed polarity monitor: triggers at 10K below measuring range

### mV input

Range	Overall error	Resolution
0...30 mV	≤45 μV	1.7 μV
0...100 mV	≤150 μV	5.6 μV
0...300 mV	≤450 μV	17 μV

**Input resistance:** ≥1 MΩ

**Break monitoring:** built in.

Sensor current: ≤ μA

### mA input

Range	Overall error	Resolution
0/4...20 mA	≤40 μA	2 μA

**Input resistance:** 10 Ω

**Break monitor:** <2mA (only for 4...20 mA)

**Over range monitor:** >22mA

## High-impedance voltage input module U\_INP

(9407-998-0x221, P-factor=8%)

**Number of channels:** 2

Measuring ranges can be combined within one module!

Range	Overall error	Resolution mV/Digit
-50...1500 mV	≤1.5 mV	0.09
0...10 V	≤10 mV	0.56

**Characteristic:** voltage-linear

**Input resistance:** >1GΩ

**Source resistance effect:** ≤0,25 mV/MΩ

**Sensor monitoring:** none

## ANALOG OUTPUTS

### D/A-converter

**Resolution:** 12 Bit

**Refresh rate:** 100 ms

### Voltage output module U\_OUT

(9407-998-0x301, P-factor =25%)

Max. 1 module, if a current output module is already used , → POWER LIMITATIONS !

**Number of channels:** 2

**Signal ranges:** 0/2...10V, -10...10V (configurable by channel)

**Resolution:** approx.. 5.4 mV/digit

**Load:** ≥ 2 kΩ

**Load effect :** ≤ 0.1%

### Current output module I\_OUT

(9407-998-0x311, P-factor=70%)

Max. 1 module, → POWER

LIMITATIONS !

Number of channels: 2

**Signal ranges:** 0/4...20mA, -20...20mA

(configurable by channel)

**Resolution:** ca. 11μA/Digit

**Load:** ≤400 Ω

**Load effect:** ≤0.1%/100Ω

## DIGITAL INPUTS/OUTPUTS

### Digital I/O Module DIDO

(9407-998-0x401, P-factor=15%)

Number of channels: 2 (configurable as input or output by channel)

Polarity protection.

### Input

**Current sink:** to IEC 1131 Type 1

Logic „0“: -3...5V

Logic „1“: 15...30V

**Measurement cycle:** 100 ms

**Galvanic isolation:** via opto-couplers

**Nominal voltage:** 24 VDC external

**Input resistance:** 5 kΩ

### Output

Grounded load (common positive control voltage)

**Switch rating:** 18...32 VDC; ≤0 mA

**Internal voltage drop:** ≤0.7 V

**Refresh-Rate:** 100 ms

**Galvanic isolation:** via opto-couplers

**Protective circuit:** thermal, switches off with overload.

### Frequency/counter Module F\_INP

(9407-998-0x411, P-factor=8%)

Number of channels: 2; function configurable by channel (not with up/down or quadrature counters!).

**Current sink:** to IEC 1131 Type 1

Logic „0“: -3...5V

Logic „1“: 15...30V

**Galvanic isolation:** via Opto-couplers

**Nominal voltage:** 24 VDC external

**Input resistance:** 12 kΩ

**Selectable functions:**

- Control input (2 channels)
- Pulse counter (2 channels)
- Frequency counter (2 channels)
- Up/down counter (1 channel)
- Quadrature counter (1 channel)

**Frequency range:** ≤20 kHz

**Signal shape:** any (square 1:1 with 20kHz)

**Gate time:** 0.1...20s adjustable (only relevant with frequency measurement)

## INFLUENCING FACTORS

**Temperature effect:** ≤0,1%/10K

**Supply voltage:** negligible

**Common mode interference:** negligible up to 50 V<sub>rms</sub>

*Series mode interference:* negligible up to 300 mV<sub>rms</sub> (TC), 30 mV<sub>rms</sub> (RT), 10 V<sub>rms</sub> (U), 5 V<sub>rms</sub> (F)

## CAN I/O-EXTENSION

Detailed technical data and functional descriptions are given in the following data sheets:

KS 800: 9498 737 31713  
KS 816: 9498 737 35913  
RM 200: 9498 737 37813

## CANopen participants: 6

recommended, others on request (KS 98-1, RM 200, and KS 800/KS 816 (any combination, 3rd party on request)

### Transmission speed:

10 / 20 / 50 / 100 / 125 / 250 / 500 / 800 / 1000 kBd, adjustable via Engineering Tool (depends on cable length). Recommendation for max. system (6 bus participants) ≥ 250 kBaud / bus-length ≤ 50m

### Bus length

≤ 1000 / 1000 / 1000 / 500 / 250 / 250 / 100 / 50 / 25 m, depends on selected transmission speed.

### Transmission mode:

Depending on the selected transmission speed and the number of CAN nodes.

- RM 200 ⇔ KS 98+: 100ms
- KS 98+ ⇔ KS 98+: ≥ 200ms
- KS 800/816 ⇔ KS 98+: 1.6 / 3.2s (200ms per channel)

### Error detection:

Automatic node monitoring (node guarding).

### Node address

KS 98+: 1...24 (Default =1)  
KS 800/ KS 816: 2...42 (Default =2)  
RM 200: 2...42 (Default =32)

### Max. system configuration with RM 200

≤ 6 analog inputs and ≤ 6 analog outputs per RM200 basic module !

For digital I/O-channels there is no limit.

Examples: 72 digital in-/outputs (without analog modules!) or 16 analog inputs and 16 analog outputs and 8 digital in-/outputs.

## Electrical connections

See connecting diagram.

Note: Control inputs di1 and di2 are not available !

## ENGINEERING TOOLS

The described functions can be processed with the following tools:  
ET/KS 98plus: from Version 6.0 onwards  
SIM/KS 98: from Version 6.0 onwards

## POWER SUPPLY

Depends on version, see Ordering Data.

### Alternating current

90...250 VAC  
Frequency: 48...62 Hz  
Power consumption: approx. 17,1 VA; 9,7 W (max. configuration).

### Universal current 24 V UC

24 VAC, 48...62 Hz/24 VDC  
Tolerance: +10...-15% AC  
18...31.2 VDC

### Power consumption

AC: approx. 14.1 VA; 9.5 Ω  
DC: 9,1 W (max. configuration).

### Behaviour after power failure

### Structure, configuration, parameters, set-points

Permanent data storage in an EEPROM

### Data for timer, programmer, integrator, counter, etc.

Temporary storage in a capacitor-buffered RAM (typical 15 min.).

### Real-time clock (optional)

Buffer capacitor provides back-up for at least 2 days (typical).

## FRONT INTERFACE PORT (STANDARD)

Front-panel socket for PC adapter (see „Accessories“). By means of the Engineering Tool ET/KS 98, the controller can be remotely structured, configured, and its parameters set.  
Protocol: ModBus or ISO1745 (selectable; identical with bus interface).

## BUS INTERFACE (OPTION B)

### TTL and RS422 / 485-interface

Galvanically isolated, choice of TTL or RS 422/485 operation.

Protocol: ModBus or ISO1745

(selectable; identical with bus interface).

### Number of controllers per bus:

With RS 422/485: 32

With TTL signals: max. 32 interface modules on one bus. Above this value, the only limit is the address range (00...99)

## PROFIBUS-DP INTERFACE

According to EN 50 170, Vol. 2.  
Reading and writing of all process data, parameters, and configuration data.

### Configurable process data modules

With the Engineering Tool max. 4 DPREAD and 4 DPWRIT functions with six analog and sixteen logic variables each can be selected.

By suitable internal connections with the inputs/outputs of these two, functions, any internal signal can be applied to the PROFIBUS-DP interface.

The parameter channel provides non-cyclical access to all operational parameters and configuration data.

Module	DPREAD	DPWRIT	Parameterchannel
a	1	1	-
b	1	1	x
c	2	2	x
d	3	3	x
e	4	4	x

### Data format

Real values are transmitted in the IEEE format (REAL) or in the 16-bit fixed point format (FIX) with one decimal digit (configurable).

### Memory requirements

Module	Read		Write	
	FIX	REAL	FIX	REAL
a	18	26	18	26
b	26	34	26	34
c	44	60	44	60
d	62	86	62	86
e	80	112	80	112

### Diagnostics/behaviour on error

The functions DPREAD and DPWRITE have digital status outputs for signaling various error conditions.

## **Transmission speeds and cable lengths**

automatic transm. speed detection

Speed	Max. cable length
9.6 kbit/s	1,200 m
187.5 kbit/s	1,000 m
500 kbit/s	400 m
1.5 Mbit/s	200 m
12.0 Mbit/s	100 m

## **Addresses**

0...126 (factory setting: 126)  
Remote addressing is possible.

## **Other functions**

Sync and Freeze

## **Connection**

AMP flat-pin connector, (via adapter to Sub-D connector, see Accessories).

## **Terminating resistors**

Internally selectable with wire-hook switches.

## **Cable**

According to EN 50 170, Vol. 2  
(DIN 19 245T3).

## **Required accessories**

Engineering Set PROFIBUS-DP, consisting of:

- GSD file, Type file
- PROFIBUS manual
- Function block(s) for Simatic S5/S7

## **DISPLAYS**

LCD point-matrix display with back lighting: colour (red/green) and display mode (direct/reverse) changable by event.

Display area: 160 x 80 points

Status LED's:

4 yellow LEDs for logic status

## **ENVIRONMENTAL CONDITIONS**

### **Permissible temperatures**

For operation: 0...60 °C

For specified accuracy: 0...55 °C

For UL-Devices: 0...50 °C

Storage and transport: -20...60 °C

Temperature effect: ≤0.15% / 10 K

### **Climatic category**

KUF to DIN 40 040

Relative humidity: ≤75% yearly average, no condensation

### **Shock and vibration**

Vibration test Fc

To DIN 68-2-6 (10...150 Hz)

Unit in operation: 1g or 0.075 mm,  
Unit not in operation: 2g or 0.15 mm

Shock test Ea  
To DIN IEC 68-2-27 (15g, 11 ms)

## **ELECTROMAGNETIC COMPATIBILITY**

Complies with EN 61326-1  
"continous, not monitored operation".

### **Electrostatic discharge**

Test to DIN EN 61000-4-2  
8 kV air discharge  
4 kV contact discharge

### **High-frequency interference**

Test to DIN EN 61000-4-3  
80...1,000 MHz, 10 V/m  
Effect: ≤ 1%

### **HF interference on leads**

Test to DIN EN 61000-4-6  
0.15...80 MHz, 10 V  
Effect: ≤ 1%

### **Fast pulse trains (burst)**

Test to DIN EN 61000-4-4  
2 kV applied to leads for supply voltage, and signal leads  
Effect: ≤ 5% resp. restart

### **High-energy single pulses (surge)**

Test to DIN EN 61000-4-5  
1 kV symmetric or 2 kV asymmetric on leads for supply voltage.  
0.5 kV symmetric or 1 kV asymmetric on signal leads.

## **GENERAL**

### **Housing**

Plug-in module, inserted from front.  
Material: Makrolon 9415,  
flame-retardant, self-extinguishing  
Flammability class: UL 94 VO

### **Protection mode**

(to EN 60 529, DIN VDE 0470)  
Front: IP 65  
Housing: IP 20  
Terminals: IP 00

### **Safety tests**

- To EN 61 010-1
- Overvoltage category: III
  - Contamination class: 2
  - Working voltage range: 300 VAC
  - Protection class: I

## **CE marking**

Meets the European Directives regarding „Electromagnetic Compatibility“ and „Low-voltage equipment“ (see also „Safety tests“)

## **Certified to DIN EN 14597**

The device may be used as temperature control and limiting equipment according to DIN EN 14597

## **cULus certification**

(Type 1, indoor use)

File: E 208286

For compliance with cULus certificate, the following information must be taken into account:

- Use only 60/75°C copper (Cu) conductors .
- Tighten the terminal-screws with a torque of 0.5 – 0.6 Nm.
- The instrument shall be mounted on a flat surface of a "Type 1 Enclosure" for "Indoor use" only.
- Ambient temperature: ≤50 °C
- Power supply: ≤250 VAC
- Max. ratings of relay contacts:  
250VAC, 2A, 500 W (resistive)  
250VAC, 2A, 360 VA (inductive)

## **Electrical connections**

Screw terminals for conductor cross-section from 0,5 - 2,5 mm<sup>2</sup>

## **Mounting method**

Panel mounting with 4 fixing clamps at top/bottom

## **Mounting position**

Not critical

## **Weight**

Approx. 0.75 kg with all options

## **Accessories**

3-language operating instructions (GB/D/F)  
4 fixing clamps

## **AUXILIARY EQUIPMENT**

Updates and Demos on the PMA-Homepage ([www.pma-online.de](http://www.pma-online.de))

## **Engineering Tool ET/KS 98plus**

### **Hardware & software platform**

- Windows 95 or higher
- Graphic resolution: at least 800 x 600 pixels.
- Operation with mouse (preferred).

## Simulation SIM/KS 98

Software package for simulating the KS 98-1 on a standard PC under Windows. All functions of the KS 98-1 are possible, plus:

- Simulation of inputs/outputs
- Trend display
- „Turbo“ mode

## PC-Adapter

Adapter cable for connecting a PC (Engineering Tool) to the front-panel interface socket of the KS 98-1.

## DELIVERY CONDITION

Every unit is delivered with a test Engineering that permits the inputs/outputs of the basic unit (not I/O extensions) to be checked without accessories.

When delivered, all units can be operated, parameterized, and configured via the front panel keys.

## ORDER EXAMPLE I/O MODULES

### Pos.1: KS 98-1

KS98-1xx-x40xx-xxx

### Pos.2: I/O module (fitted in Pos.1)

Slot 1: 9407-998-01201 (Pt 100)  
 Slot 2: 9407-998-02301 (I-output)  
 Slot 3: 9407-998-03311 (U-output)  
 Slot 4: free

### Survey of P-factors

(Sum ≤ 100 % !)

R_INP:	5%	I_OUT:	70%
TC_INP:	5%	DIDO:	15%
U_INP:	8%	F_INP:	8%
U_OUT:	25%		

## ORDERING INFORMATION I/O-MODULES

	9	4	0	7	9	9	8	0			1
<i>Sockets</i>									<b>0</b>		
<i>Module group 1</i>									<b>1</b>		
									<b>2</b>		
<i>Module group 2</i>									<b>3</b>		
									<b>4</b>		
<i>ANALOG INPUTS</i>									<b>2</b>	<b>0</b>	
									<b>2</b>	<b>1</b>	
									<b>2</b>	<b>2</b>	
<i>ANALOG OUTPUTS</i>									<b>3</b>	<b>0</b>	
									<b>3</b>	<b>1</b>	
<i>DIGITAL SIGNALS</i>									<b>4</b>	<b>0</b>	
									<b>4</b>	<b>1</b>	

3) Specify when ordering: "Fitted in KS98-1, position X of order"

4) Max. 1 current output module (→ "POWER LIMITATION")!

## ORDERING INFORMATION RM-MODULES

### Bus coupler module

<b>RM 201</b> CANopen coupler (for TC/Pt)	9	4	0	7	7	3	8	2	0	1	0	1
<b>RM 201-1</b> CANopen coupler (strain gauge transm.)	9	4	0	7	7	3	8	2	0	1	1	1

### Basic modules

<b>RM 211</b> Basic module 3 slots	9	4	0	7	7	3	8	2	1	1	0	1
<b>RM 212</b> Basic module 5 slots	9	4	0	7	7	3	8	2	1	2	0	1
<b>RM 213</b> Basic module 10 slots	9	4	0	7	7	3	8	2	1	3	0	1
<b>RM 214</b> Dummy panel	9	4	0	7	7	3	8	2	1	4	0	1

### Analog inputs

<b>RM 221-0</b> Analog inputs 4 x I	9	4	0	7	7	3	8	2	2	1	0	1
<b>RM 221-1</b> Analog inputs 4 x U	9	4	0	7	7	3	8	2	2	1	1	1
<b>RM 221-2</b> Analog inputs 2 x I, 2 x U	9	4	0	7	7	3	8	2	2	1	2	1
<b>RM 222-0</b> Analog inputs 4 x I, transm. supply	9	4	0	7	7	3	8	2	2	2	0	1
<b>RM 222-1</b> Analog inputs 4 x U/Pot, transm. supply	9	4	0	7	7	3	8	2	2	2	1	1
<b>RM 222-2</b> Analog inputs 2 x I, 2 x U/Pot, transm. supply	9	4	0	7	7	3	8	2	2	2	2	1
<b>RM 224-0</b> Analog inputs 2 x TC, galv. isolated	9	4	0	7	7	3	8	2	2	4	0	1
<b>RM 224-1</b> Analog inputs 4 x TC, Pt100	9	4	0	7	7	3	8	2	2	4	1	1
<b>RM 224-2</b> Analog inputs 1 x mV, 1 x TC, galv. isolated	9	4	0	7	7	3	8	2	2	4	2	1
<b>RM 225</b> Analog inputs 2 x DMS (strain gauge)	9	4	0	7	7	3	8	2	2	5	0	1

### Analog outputs

<b>RM 231-0</b> Analog outputs 4 x I/U(+10V)	9	4	0	7	7	3	8	2	3	1	0	1
<b>RM 231-1</b> Analog outputs 4xI / 2 x U(+10V), 2 x U(±10V)	9	4	0	7	7	3	8	2	3	1	1	1
<b>RM 231-2</b> Analog outputs 4 x I/U (±10V)	9	4	0	7	7	3	8	2	3	1	2	1

### Digital inputs

<b>RM 241</b> Digital inputs 4 x 24V DC	9	4	0	7	7	3	8	2	4	1	0	1
<b>RM 242</b> Digital inputs 8 x 24V DC	9	4	0	7	7	3	8	2	4	2	0	1
<b>RM 243</b> Digital inputs 4 x 230V AC	9	4	0	7	7	3	8	2	4	3	0	1

### Digital outputs

<b>RM 251</b> Digital outputs 8 x 24V DC/0,5A	9	4	0	7	7	3	8	2	5	1	0	1
<b>RM 252</b> Digital outputs 4 x relays 230V AC, 5A	9	4	0	7	7	3	8	2	5	2	0	1

Please mind footnotes!  
KS98-1 with screw terminals  
only!

	<b>K   S   9   8   -   1   0   -   0   0   -   0   0  </b>
<b>BASIC UNIT</b>	KS 98 Standard KS 98 with transmitter power supply KS 98 with CANopen I/O <sup>1)</sup>
<b>POWER SUPPLY AND CONTROL OUTPUTS</b>	90...250V, AC 4 relays 24V UC, 4 relays 90...250V AC, 2 relays+ 2 mA/logic 24V UC, 2 relays+ 2 mA/logic
<b>OPTION B INTERFACE</b>	no interface TTL interface + di/do RS422 + di/do + clock PROFIBUS DP + di/do
<b>OPTION C (standard)</b>	no extensions INP3, INP4, OUT3, di/do
<b>OPTION C (modular)</b>	Motherboard without modules <sup>2)</sup> Motherboard ordered modules inserted <sup>2)</sup>
<b>SETTING</b>	Standard configuration Customer-specific configuration
	Operating instruction <sup>3)</sup>
<b>APPROVALS</b>	Standard (CE certification) cULus approval DIN EN 14597 certified

1) Not possible with Modular Option C!  
RM 200 not included in cULus approval !

2) Not possible with CANopen ! I/O modules must be ordered separately!  
Mind possible combinations and power limitations; → Text!

3) Detailed system manual can be ordered separately or downloaded ([www.pma-online.de](http://www.pma-online.de))

## Accessories

PC-Adapter for Engineering Tools	<b>9407 998 00001</b>
USB Serial adapter	<b>9407 998 00081</b>
Engineering Tool ET/KS 98plus	<b>9407 999 06401</b>
Engineering Tool ET/KS 98plus (10)	<b>9407 999 06411</b>
ET/KS 98plus Update	<b>9407 999 06421</b>
Downloader DL/KS 98-1	<b>9407 999 06501</b>
BlueControl® Basic	<b>9407 999 13001</b>
Simulation SIM/KS 98	<b>9407 999 08801</b>
Simulation SIM/KS 98 (10)	<b>9407 999 08811</b>
SIM/KS 98 Update	<b>9407 999 08821</b>
PMATune – PID optimization	<b>9407 999 06601</b>
PMATune – PID optimization (5)	<b>9407 999 06611</b>
ADAM interface converter RS 232-RS 422/485	<b>ADAM -4520-D</b>
ES KS 98/PROFIBUS (DE)	<b>9407 999 10011</b>
ES KS 98/PROFIBUS (EN)	<b>9407 999 10001</b>
PROFIBUS Sub-D connector for screw terminals	<b>9407 998 00091</b>

## Documentation

Operating instructions KS 98-1 / KS 98+ (DE/EN/FR)	<b>9499 040 82501</b>
Operating instructions ET/KS 98plus	<b>9499 040 45701</b>
Interface description PROFIBUS-Protocol (DE)	<b>9499 040 82818</b>
Interface description PROFIBUS-Protocol (EN)	<b>9499 040 82811</b>
Interface description ISO 1745-Protocol (DE)	<b>9499 040 82918</b>
Interface description ISO 1745-Protocol (EN)	<b>9499 040 82911</b>
Manual KS 98-1 / KS 98+ (D)	<b>9499 040 83218</b>
Manual KS 98-1 / KS 98+ (E)	<b>9499 040 83211</b>
Manual KS 98-1 / KS 98+ (F)	<b>9499 040 83232</b>
ModBus interface description (DE)	<b>9499 040 88718</b>
ModBus interface description (EN)	<b>9499 040 88711</b>

## Services

Engineering according to customer specification	<b>DIKS ENG 98003</b>
Workshop with customer project (2 days)	<b>DIKS TRA 00037</b>
Other services on request	